



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application of : Tom DAVISSON et al.
Serial No. : 10/051,873
Date Filed : January 17, 2002
For : COMPOSITION AND METHOD OF FORMING
ALUMINUM ALLOY FOIL
Examiner : Janelle Combs-Morillo
Art Unit : 1742

COOPER & DUNHAM LLP
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April 5, 2004

Commissioner for Patents
P.O. Box 1450
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Sir:

DECLARATION OF SADASHIV NADKARNI

I, Sadashiv Nadkarni, hereby declares as follows:

1. I am Senior Scientist at Alcan Rolled Products. I make this declaration under 37 C.F.R. § 1.132, in support of U.S. Patent Application Serial No. 10.051,873, filed on January 17, 2002.

2. I attended Indian Institute of Technology in Bombay, India. I graduated in 1967 with a Bachelor of Technology degree in Chemical Engineering. After graduation, I joined Indian Aluminum Company, a subsidiary of Alcan Aluminum. From 1967 until 1981, I worked as a technical assistant and later as superintendent of Research & Development for smelters.

3. In 1981, I joined the Alcan Arvida Research Center in Jonquiere, Quebec, Canada. I was initially Program Manager for Carbon Technology. I was then Senior Consultant in the New Products Group, and I was responsible for research and development of new products in the areas of alloys, ceramics, and coatings. In 1990, I moved to an Alcan research facility in Cambridge, Massachusetts. My position was Senior Scientist, and my responsibilities included development of coatings and alloys. In 1994, I joined Alcan Rolled Products, again as Senior Scientist. In this capacity, I have been developing new alloys for aluminum sheet, coatings, as well as process improvements, and other aspects of aluminum sheet production. I hold over 20 U.S. Patents, all assigned to Alcan.
4. I am one of the named inventors in the above-identified application. I have received a copy of the November 19, 2003 Office Action and the references cited therein. I understand the Examiner has asserted that the invention claimed in our patent application is either anticipated by or would have been obvious in view of the cited Toma and Sircar references. I respectfully disagree with the Examiner's conclusions.
5. By way of background, the aluminum alloy of the present invention is designed for automobile finned tubing heat exchanger

applications. Generally, such finned tubing applications include two types, those that are fitted and those that are brazed. Fitted systems are assembled at room temperature. The fin is slid over a tube and then the tube is expanded to make the joint strong. Brazed systems are those where a clad tube and the fin are brazed together at temperatures at or above about 600°C. Brazed finned tubing is stronger, and is favored for use in automobiles. However, heat exchanger fins for automobile air conditioning must provide sufficient sag resistance, otherwise their systems can lose their shape and strength. Sag resistance is the ability of the fins to resist bending at brazing temperatures.

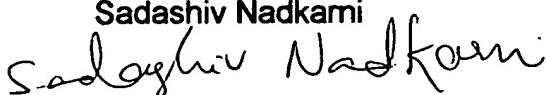
6. We have observed that sag resistance is strongly correlated to the grain size of the material. Large pancake shaped grains (80-150 microns) provide the fin a high sag resistance. Small sized grains (less than 40 microns) provide high formability, but such fins sag badly during brazing, rendering the unit unusable. However, if the grain size becomes too large (over 200 microns), then the sheet can become very brittle and difficult to roll. Thus, apart from mechanical properties, control of grain size is the most important parameter that determines whether a particular alloy is suitable or not for the brazed fin applications.

7. We have achieved control of grain size by two means: (1) by strictly controlling the amount of manganese, iron and silicon (high iron levels can result in low grain size); and (2) by using continuous casting to maintain manganese in solution (DC casting and hot rolling involves preheating of ingots at 500°C, which results in manganese (Mn) precipitation).
8. The control of grain size in the desired range would be completely destroyed by adding titanium and zirconium. Both of these elements are well-known grain refiners. Adding these elements, even in small quantities, will destroy the balance that is achieved between Mn and Fe, which helps to maintain the grain size in the optimal range. The leading treatise, Aluminum, Properties, Physical Metallurgy, and Phase Diagrams, page 208, Kent Van Horn (ed.), confirms this, where it states, "In small quantities up to 0.25%, zirconium produces grain refining effect in aluminum and its alloys.... Zirconium alone or with titanium in weld filler wire decreases grain size." A copy of this excerpt is attached hereto as Exhibit 1.
9. Whereas a grain refining effect may be desirable in fitted fin applications, it would certainly be deleterious to the brazed fin applications for which the present alloy is designed. Ti and Zr also result in higher work hardening rate of the resulting alloy.

Therefore, addition of Ti and Zr can result in lower productivity in the rolling mills. In addition, scrap containing these two elements loses value as well, as they are more difficult to recycle than aluminum alloys omitting them.

10. Therefore, where a person of ordinary skill seeks to improve the properties of an aluminum alloy by increasing its grain size, he or she would not add titanium or zirconium to the alloy, as it would reduce grain size. In the present invention, that would decrease sag resistance, which would weaken the strength of the alloy and the heat exchanger made from fins of the alloy.
11. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Dated: April 11, 2004


Sadashiv Nadkarni


ALUMINUM

Vol. I. Properties,
Physical Metallurgy.

and Phase Diagrams

ALUMINUM

Vol. I. Properties, Physical Metallurgy, and Phase Diagrams

Vol. II. Design and Application

Vol. III. Fabrication and Finishing

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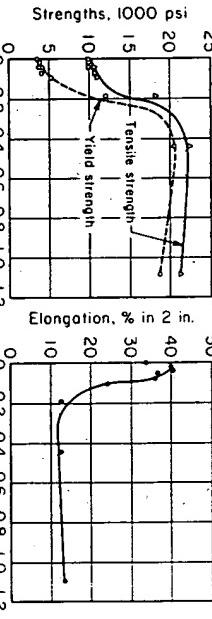


Fig. 38. Effect of zirconium on tensile properties of wrought 99.8 Al, 0.064-in. specimens, annealed at 650 F (P. T. Stroup, Alcoa)

Aluminum-Zirconium. In small quantities up to 0.25%, zirconium produces grain-refining effects in aluminum and its alloys. The effect of up to 1% Zr on the tensile properties of annealed 99.8 Al is shown in Fig. 38. Zirconium, alone or with titanium, in weld filler wire decreases grain size and reduces cracking in the weld. In an aluminum-copper alloy, when present with vanadium and manganese, zirconium increases long-time properties at elevated temperatures, such as 600 F.

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Chapter 7

Resistance to Corrosion and Stress Corrosion

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ALUMINUM and aluminum alloys are selected as materials of construction in many fields because of their ability to resist corrosion. Although aluminum is an active metal, its behavior is stable, because of the protective, tightly adherent, invisible oxide film on its surface. When disrupted, this film begins to reform immediately in most environments. The film developed in air on a freshly abraded aluminum surface is about 50 to 100 Å thick.

Causes of Corrosion

In most environments, the corrosion of aluminum (like that of other common structural metals) is associated with the flow of electric current between various anodic and cathodic regions. Electrochemical corrosion produced depends on the potentials of these regions. Investigations on the electrochemistry of corrosion of aluminum led to the choice of a solution containing 53 g per liter of sodium chloride and 3 g per liter of hydrogen peroxide for measuring potentials (1). The potentials of several metals and aluminum alloys measured against a 0.1N calomel reference electrode in the standard NaCl-H₂O₂ solution are listed in Table I. However, to establish the potential difference between aluminum and some dissimilar metal under operating conditions, it is necessary to

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